



Westinghouse Non-Proprietary Class 3

Advanced Logic System ALS II Quality Assurance Plan

6003-00001-NP,
Rev. 0

Nuclear Safety Related

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APPROVALS

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WESTINGHOUSE NON-PROPRIETARY CLASS 3

LIST OF CONTRIBUTORS

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REVISION HISTORY**RECORD OF CHANGES**

Revision	Author	Description	Completed
0	Mark R. Angelini	This QAP is applicable to Phase 1 development of the ALS II platform version and it reflects the transition of the ALS product line from CSI to Westinghouse. The QAP for ALS platform development is 6002-00001.	See EDMS

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ACRONYMS AND TRADEMARKS

Acronyms used in the document are defined in 6002-00040, “ALS Terms and Abbreviations” (Reference 2); or included below to ensure unambiguous understanding of their use within this document.

Acronym	Definition
CAPAL	Corrective Action, Prevention, and Learning
IRC	Issue Review Committee
PQP	Project Quality Plan
QAP	Quality Assurance Plan
QMS	Quality Management System
SCO	Scottsdale Operations
SER	Safety Evaluation Report

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GLOSSARY OF TERMS

Standard terms used in the document are defined in 6002-00040 (Reference 2) to ensure unambiguous understanding of their use within this document.

Term	Definition
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None.	
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REFERENCES

Following is a list of references used throughout this document. Revision levels are “latest” unless otherwise specified.

1. 6002-00030, “Advanced Logic System Design Tools,” Westinghouse Electric Company LLC.
2. 6002-00040, “ALS Terms and Abbreviations”
3. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 3.18, “FPGA-based Project Planning and Execution.”
4. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 4.51, “Field Programmable Gate Array Development Procedure.”
5. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 18.1, “In-Process Software Audits.”
6. Westinghouse Electric Company Level 2 Procedure WEC 7.10, “Quality Oversight at Supplier Facilities.”
7. Westinghouse Electric Company Level 2 Procedure WEC 16.2, “Westinghouse Corrective Actions Process.”
8. IEEE Std 730-1998, “Standard for Software Quality Assurance Plans,” Institute of Electrical and Electronics Engineers, 1998.
9. 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” U.S. Nuclear Regulatory Commission (NRC).
10. ISO 9001, “Quality Management Systems – Requirements,” International Organization for Standardization.
11. ASME NQA-1- 2008/2009a, “Quality Assurance Program Requirements for Nuclear Facilities/with Addenda,” American Society of Mechanical Engineers.
12. 10 CFR Part 21, “Reporting of Defects and Noncompliance,” U.S. NRC.
13. Westinghouse Electric Company Level 2 Procedure WEC 6.1, “Document Control.”
14. Westinghouse Electric Company Level 2 Procedure WEC 2.2, “Project Quality Plan.”
15. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 4.37, “Configuration Management.”

REFERENCES (cont.)

16. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 4.48, "Component/Sub-assembly Hardware Design Process."
17. Westinghouse Electric Company Level 2 Procedure WEC 18.1, "Internal Audits."
18. Westinghouse Electric Company Level 2 Procedure WEC 3.3.1, "Design Reviews."
19. Westinghouse Electric Company Level 2 Procedure WEC 17.1, "Records."
20. Westinghouse Electric Company Level 2 Procedure WEC 7.1, "Supplier QA Program Qualification and Assessment."
21. Westinghouse Electric Company Level 2 Procedure WEC 7.5, "Control of Purchased Items and Services."
22. Westinghouse Electric Company Level 2 Procedure WEC 2.6, "Training."
23. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 2.8, "Training Oversight."
24. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 3.15, "Project Risk Management."
25. 6002-00301-P-A, Rev 4, "Advanced Logic System Topical Report," Westinghouse Electric Company LLC.
26. 6003-00000, "ALS II Project Management Plan," Westinghouse Electric Company LLC.
27. WNA-PS-00042-GEN, "Isolated Development Infrastructure (IDI) Acceptable Use Policy," Westinghouse Electric Company LLC.
28. WNA-PS-00034-GEN, "Software Import-Export Procedure," Westinghouse Electric Company LLC.
29. 9006-01501, "Defect Management Work Instruction," Westinghouse Electric Company LLC.
30. 9006-00602, "Advanced Logic Systems Document Management and Storage," Westinghouse Electric Company LLC.
31. 9008-00026, "FPGA Review Checklist," Westinghouse Electric Company LLC.
32. 6003-00301-P-A, "Advanced Logic System Topical Report Addendum," Westinghouse Electric Company LLC.

REFERENCES (cont.)

33. Westinghouse Electric Company Automation and Field Services Level 3 Procedure NA 15.1, "Control of Nonconformances"
34. 6003-00010, "ALS II Platform Requirements Specification," Westinghouse Electric Company LLC.
35. 6003-00011, "ALS II Platform Specification," Westinghouse Electric Company LLC.
36. 6002-00006, "ALS Security Plan," Westinghouse Electric Company LLC.
37. 6003-00003, "ALS II Verification and Validation Plan," Westinghouse Electric Company LLC.
38. 6002-00002, "ALS Configuration Management Plan," Westinghouse Electric Company LLC.
39. 6003-00004, "ALS II Equipment Qualification Plan," Westinghouse Electric Company LLC.
40. 6003-00005, "ALS II Test Plan," Westinghouse Electric Company LLC.
41. WNA-IG-00097-GEN, "Standard and Project Documentation Creation Guidelines," Westinghouse Electric Company LLC.
42. IEEE Std. 1028-1997, "IEEE Standard for Software Reviews and Audits," Institute of Electrical and Electronics Engineers, Inc., 1997.

SECTION 1

PURPOSE

This Quality Assurance Plan (QAP) defines the techniques, procedures, and methodologies that Westinghouse Electric Company, LLC (WEC) will use to assure quality in the design and test developments of the Advanced Logic System[®] (ALS[®]) Platform. It specifically addresses the quality program plan for the ALS platform as defined by 6003-00000, “ALS II Project Management” (Reference 26).

This QAP was written using IEEE STD 730-1998, “Standard for Software Quality Assurance Plans” (Reference 8) as guidance. It covers the entire Field Programmable Gate Array (FPGA) development process, which includes processes such as Requirements Specification, Design, Implementation, Source/Data Control, Reviews, Change Management, and Configuration Management.

The QAP is a platform-specific Quality Assurance Plan applied along with the 18 point criteria of 10 CFR Part 50, Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants” (Reference 9), ISO 9001, “Quality Management Systems – Requirements” (Reference 10 – the most recent edition prior to the required compliance date), and ASME NQA-1-2008/2009a, “Quality Assurance Program Requirements for Nuclear Facilities/with Addenda” (Reference 11). It also includes the reporting requirements of 10 CFR Part 21, “Reporting of Defects and Noncompliance” (Reference 12).

Compliance with the Westinghouse Quality Management System (QMS) is achieved by implementing Westinghouse Level 2 and Westinghouse Automation and Field Services (AFS) Level 3 Procedures, as identified in Section 16.

1.1 SCOPE

Westinghouse is responsible for supplying the ALS equipment, systems and components for nuclear power generating facilities. ALS boards are generic boards that can be configured for different applications. Because of this, the ALS board lifecycle spans the ALS board development and integration into an application-specific system, including Class-1E safety related or mission-critical systems. Its objective is to develop and produce generic ALS boards for stock and then program them later for integration into dedicated systems.

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(Last Page of Section 1)

SECTION 2

REFERENCE DOCUMENTS

See page viii for reference documents.

SECTION 3 MANAGEMENT

3.1 ALS PROJECT ORGANIZATION

The project management plan (Reference 26) documents the relationship between ALS organizational units, along with roles and responsibilities. Reference 26 describes the primary internal and external project interfaces and their interactions. It requires the Quality Assurance (QA) team to be independent from the development organization– including project cost and schedule requirements.

Personnel associated with the Design Team will perform ALS development efforts within this document's scope. Personnel associated with the Quality team will perform quality efforts within this document's scope.

3.2 TASKS

ALS was developed per Westinghouse AFS Level 3 Procedure NA 3.18, "FPGA-based Project Planning and Execution" (Reference 3). [

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3.3 RESPONSIBILITIES

This section – and other sections of this document – define responsibilities relative to this QAP's content. The ALS II project management plan (Reference 26) defines additional responsibilities for the overall ALS II Phase 1 execution.

3.3.1 Quality Assurance

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The QA personnel interact with the Design Team to function effectively and meet their goals. Quality must:

- Participate in project meetings as appropriate
- Participate in the design review process
- Perform surveillances and audits of the various development activities
- Report results of activities periodically

3.3.2 Independent Verification and Validation

For the ALS Phase 1 project, Independent Verification and Validation (IV&V) will be performed as defined in Section 4.4.

3.3.3 Project Management

The Project Manager is responsible for overall project execution as defined in the ALS II project management plan (Reference 26). Quality-specific tasks include tracking of metrics using OnTime[®] tickets throughout the duration of the project; scheduling in-process audits and managerial reviews; and defining and tracking ALS II Project team training.

3.3.4 Design Team

The Design Team is responsible for developing and reviewing requirements and design documentation; design testing; and participating in scheduled audits and design reviews.

SECTION 4 DOCUMENTATION

This section lists the primary documents for a platform development. The project management plan (Reference 26) provides the complete definition of the overall document hierarchy. Document structure and format follow the guidance provided in WNA-IG-00097-GEN, “Standard and Project Documentation Creation Guidelines” (Reference 41).

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4.1 MANAGEMENT PLAN

The ALS II Phase 1 project management plan (Reference 26), describes the project’s management aspects, such as organization, responsibilities, security aspects, project life cycle and schedule with milestones.

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4.2 QUALITY ASSURANCE PLAN

Per WEC 2.2, “Project Quality Plan” (Reference 14), the PM is responsible for issuing, and maintaining this QA Plan, with the Quality Manager’s review and approval. This QAP serves as both the PQP (per WEC 2.2) and the Software QAP.

4.3 TEST PLAN

The test plan – 6003-00005, “ALS II Test Plan” (Reference 40) – describes the planned scope, approach, resources and schedule for testing activities. [

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4.4 INDEPENDENT VERIFICATION AND VALIDATION (VV) PLAN

The VV Plan – 6003-00003, “ALS II Verification and Validation Plan” (Reference 37) – describes procedures, responsibilities, and requirements for a comprehensive evaluation of the item being

developed. Relative to the development's software aspects, the VV Plan defines the methods (such as inspection, analysis, or test) used to:

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The scope of the above tasks is limited by the scope of ALS II Phase 1 and will be specifically defined within the VV Plan. The plan requires the results of the verification and validation be documented in a report that summarizes the IV&V activities for each phase and the results of the activities.

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] ^{a,c,e} Additional IV&V analysis and testing will be necessary for the ALS-153 board.

4.5 CONFIGURATION MANAGEMENT (CM) PLAN

The CM plan – 6002-00002, “ALS Configuration Management Plan” (Reference 38) – describes the planned method for Configuration Item (CI) change control throughout the project life cycle. [

] ^{a,c,e} WEC 6.1, “Document Control”

(Reference 14); NA 3.18 (Reference 3) and 9006-00602, “Advanced Logic Systems Document Management and Storage” (Reference 30) provide version control guidance.

4.6 EQUIPMENT QUALIFICATION (EQ) PLAN

The EQ plan – 6003-00004, “ALS II Equipment Qualification Plan” (Reference 39) – presents and defines methodologies and procedures used to conformance/type test a representative test specimen according to the requirements listed in the requirements specification. The EQ plan will normally include electromagnetic compatibility (EMC), environmental, and seismic testing.

4.7 ALS PLATFORM REQUIREMENTS SPECIFICATION

The Design Team writes the requirements specification – 6003-00010, “ALS II Platform Requirements Specification” (Reference 34) – which contains the platform requirements. IV&V reviews the requirements relative to their impact on FPGA coding, as defined in the VV Plan.

The platform requirements specification focuses on common architectural aspects of the ALS design such as inter-board communication, backplane connector definitions, mechanical constraints on the system and other general ALS board requirements.

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4.8 ALS-XXX BOARD REQUIREMENTS SPECIFICATION

Separate documents define the requirements for each individual platform board. The board requirements completely define an individual board's characteristics and behavior. A given board's software and hardware requirements can be combined in a single document or separated between different documents, consistent with the hierarchical relationship defined in the ALS II Project Management Plan, 6003-00000 (Reference 26). For ALS II, documents numbered 6003-XXX01, where XXX represents the applicable board number, contain board requirements. Documents numbered 6003-XXX06, where XXX represents the applicable board number, contain associated FPGA design requirements. [

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4.9 DESIGN SPECIFICATIONS (HARDWARE)

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] ^{a,c,e} Design specifications contain a detailed design description of the platform components excluding the internal FPGA design. Physical and operational characteristics of the platform chassis and boards are defined including the core logic, input and output types, and communication. The platform hardware design specifications are contained in 6003-00011, "ALS II Platform Specification" (Reference 35). The hardware design specification for each board is contained in a document numbered 6003-XXX02, where XXX represents the applicable board number.

4.10 FPGA DESIGN DESCRIPTIONS (SOFTWARE)

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Documents numbered 6003-XXX03 (for Core A logic) or 6003-XXX04 (for Core B logic) – where “XXX” represents the applicable board number – contain each board’s FPGA SDD.

4.11 USER DOCUMENTATION

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A user manual contains sufficient FPGA (software) information to permit users to successfully execute “software.” All error messages and appropriate corrective actions will be defined. A method of reporting errors to Westinghouse will be identified.

SECTION 5 STANDARDS, PRACTICES, CONVENTIONS, AND METRICS

5.1 PURPOSE

This section defines the applicable standards, practices, conventions, and metrics to be applied to the ALS II Phase 1 project. Compliance with each item will be monitored and assured through training as defined in the project management plan (Reference 26). Reference 26 may define additional items as applicable.

IEEE Standard 730 (Reference 8) was used as guidance in preparing this plan.

5.2 DOCUMENTATION STANDARDS

The project management plan – 6003-00000, “ALS II Project Management Plan” (Reference 26) – and the supporting plans referenced therein, define the standards applicable to the overall development effort. The overall life cycle activities, products, and documentation are defined by NA 3.18, “FPGA-based Project Planning and Execution” (Reference 3); and in Reference 26.

5.3 LOGIC STRUCTURE STANDARDS

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5.4 CODING STANDARDS

For any new software activities in ALS II Phase 1, the software development will be performed in accordance to NA 4.51, “Field Programmable Gate Array (FPGA) Development Process” (Reference 4). This applies specifically to the development of minor logic changes required by the ALS-153 as identified in the project management plan (Reference 26).

5.5 COMMENTARY STANDARDS

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]^{a,c,e} Document 9006-01501, “Defect Management Work Instruction” (Reference 29) will be followed to capture, track/monitor, and close defects/bugs.

5.6 NONCONFORMANCES

Identification and resolution of hardware nonconformances are handled per NA 15.1, “Control of Nonconformances” (Reference 33).

5.7 TESTING STANDARDS AND PRACTICES

Testing is performed per 6003-00005, “ALS II Test Plan” (Reference 40).

IV&V performs verification and validation testing per 6003-00003, “ALS II Verification and Validation Plan” (Reference 37).

5.8 PROCESS METRICS

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Trend analysis is performed and corrective actions are established, as defined in the project management plan (Reference 26).

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SECTION 6 REVIEWS AND AUDITS

6.1 PURPOSE

This section defines the minimum technical and managerial reviews and audits to be performed. The project management plan 6003-00000 (Reference 26) and 6003-00003, “ALS II Verification and Validation Plan” (Reference 37) can include requirements for additional reviews and audits.

The QA team has the authority and freedom to perform planned and unplanned monitoring activities (for example, audits, assessments or reviews) at any time during the ALS II project life cycle.

IEEE Std. 1028-1997, “IEEE Standard for Software Reviews and Audits” (Reference 42) lists five types of software reviews. The reviews defined in Reference 42 are addressed as follows:

1. Managerial Reviews – section 6.9 of this QAP.
2. Technical Reviews – “design reviews” per WEC 3.3.1 (Reference 18), and sections 6.3 and 6.4 of this QAP.
3. Inspections – section 4.4 of the ALS II QAP.
4. Walk-throughs – WEC 3.3.1 (Reference 18), IV&V plan (Reference 37) and design reviews per WEC 3.3.1 (Reference 18).
5. Audits – section 6.8 of this QAP

6.2 SOFTWARE REQUIREMENTS REVIEW

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^{a,c,e} The FPGA design team reviews the FPGA software requirements according to NA 4.51, “Field Programmable Gate Array (FPGA) Development Procedure” (Reference 4). The FPGA design team also reviews the FGPA design documentation and code releases per NA 4.51. The reviews are performed and documented via 9008-00026, “FPGA Review Checklist” (Reference 31).

6.3 PRELIMINARY DESIGN REVIEW

For ALS II Phase 1, the preliminary design review is a review of the platform requirements defined in 6003-00010, “ALS II Platform Requirements Specification” (Reference 34), and board requirements defined in the documents numbered 6003-xxx01. Preliminary Design Reviews are conducted per WEC 3.3.1, “Design Reviews” (Reference 18).

6.4 CRITICAL DESIGN REVIEW

The critical design review is equivalent to the final design review per the “final design review” definition in WEC 3.3.1, “Design Reviews” (Reference 18). The final design review is conducted according to WEC 3.3.1. At the PM’s and the responsible design manager’s discretion, an intermediate design review may be performed in addition to the final design review.

6.5 SOFTWARE VERIFICATION AND VALIDATION PLAN REVIEW

Verification and validation of the FPGA is performed, as applicable for ALS II Phase 1, as defined in 6003-00003, “ALS II Verification and Validation Plan” (Reference 37) and 6003-00000, “ALS II Project Management Plan” (Reference 26). The VV Plan is reviewed and approved per WEC 6.1.

6.6 FUNCTIONAL AUDIT

Functional Audits (FAs) verify that the configuration item meets the functional requirements including performance. The FA helps confirm that there are no unintended functional characteristics. IV&V conducts this audit via the requirements traceability analyses defined in the VV Plan.

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6.7 PHYSICAL AUDITS

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6.8 IN-PROCESS AUDITS

In-process audits verify design consistency including the following, consistent with the reduced scope of ALS II Phase 1:

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Quality performs oversight of the ALS II development and related processes. Quality conducts in-process audits per WEC 18.1 “Internal Audits” (Reference 17) and NA 18.1 “In-process Software Audits” (Reference 5). The scope of the in-process audits will also include an assessment of the effective implementation of the security practices described in 6002-00006, “ALS Security Plan” (Reference 36).

6.9 MANAGERIAL REVIEWS

Managerial reviews are performed in accordance with in 6003-00000, “ALS II Project Management Plan” (Reference 26) and the VV Plan, 6003-00003, “ALS II Verification and Validation Plan” (Reference 37). Managerial reviews assess the execution of the actions and items identified in this QAP.

6.10 SOFTWARE CONFIGURATION MANAGEMENT PLAN REVIEW

IV&V review of the plan 6002-00002, “ALS Configuration Management Plan” (Reference 38) is conducted during the planning phase of the lifecycle. IV&V performs an assessment to verify that the methods defined in the plan are complete and adequate.

6.11 POST-MORTEM REVIEW

The post-mortem reviews are conducted per the project closeout plan in 6003-00000, “ALS II Project Management Plan” (Reference 26). This review is held at the conclusion of the project to assess the development activities implemented on that project and to provide recommendations for appropriate actions.

SECTION 7 TESTS

Tests including V&V tests are performed per the test plan 6003-00005, “ALS II Test Plan” (Reference 40).

SECTION 8

PROBLEM REPORTING AND CORRECTIVE ACTION

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Audit findings and results are also documented per WEC 16.2 (Reference 7).

Software and software document issues are handled per 9006-01501, “Defect Management Work Instruction” (Reference 29).

SECTION 9

TOOLS, TECHNIQUES, AND METHODOLOGIES

The tools used for the ALS Project, and the activities to which they apply, are defined by 6002-00030, “Advanced Logic System Design Tools” (Reference 1) and 6003-00003, “ALS II Verification and Validation Plan” (Reference 37). These tools are used for design activities and software quality assurance (i.e., IV&V) activities. [

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Standard commercial software packages, e.g., Microsoft Excel[®], Microsoft Word[®], Adobe Acrobat[®], are used to create reports and other documentation. The packages are not used to create customer delivered software.

SECTION 10 CODE CONTROL

Software and design data are maintained in a separate project repository managed by a version control system. Requirements for the control of software are described in the ALS CM plan 6002-00002, “ALS Configuration Management Plan” (Reference 38).

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SECTION 11

MEDIA CONTROL

The methods used for media control are identified in WNA-PS-00042-GEN, “IDI Acceptable Use Policy” (Reference 27) and WNA-PS-00034-GEN, “IDI Software Import-Export Process” (Reference 28). Media control is also addressed by 6002-00006, “ALS Security Plan” (Reference 36).

SECTION 12 SUPPLIER CONTROL

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SECTION 13
RECORDS COLLECTION, MAINTENANCE, AND RETENTION

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SECTION 14 TRAINING

Training for ALS II Project personnel is planned and executed per WEC 2.6, “Training” (Reference 22) and NA 2.8, “Training Oversight” (Reference 23). [

provided in the project management plan (Reference 26).]^{a,c,e} Additional details are

SECTION 15

RISK MANAGEMENT

Project risk management is conducted per NA 3.15, “Project Risk Management” (Reference 24) as supplemented by the project management plan (Reference 26). Risks are managed and discussed during regular project meetings and maintained by the PM.

SECTION 16

QUALITY ASSURANCE PROCEDURES

Westinghouse Quality Management System (QMS) compliance is achieved by implementing Westinghouse Level 2 and AFS Level 3 Procedures. [

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Table 16-1. Project Quality Procedures – Level 2

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Table 16-2. Project Quality Procedures – Level 3

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